

Claims

1. (currently amended) A method for presenting lighting characteristics associated with a display object in real-time, comprising:

executing a ray tracing algorithm through a stream processor, the executing including;

generating a ray associated with a point on the display object; and

determining an approximation of a transfer function component using at least one basis function, the approximation corresponding to a center point of a texel associated with a corresponding point on the display object.

2. (original) The method of claim 1, wherein the method operation of determining an approximation of a transfer function component using at least one basis function includes,

determining whether the ray is within a view plane of a light source.

3. (original) The method of claim 2, wherein if the ray is within the view plane of the light source, then the method includes,

determining a direct illumination component of the lighting characteristic.

4. (original) The method of claim 2, wherein if the ray is not within the view plane of the light source, then the method includes,

determining a self interreflection component of the lighting characteristic.

5. (currently amended) The method of claim 1, further comprising:  
repeating the determining of an approximation of a transfer function component  
for a series of basis functions without accessing a pre-calculated geometry associated  
with the object; and

rendering the display object using the approximation of the transfer function  
component for the series of basis functions.

6. (currently amended) A method for determining secondary illumination  
features for an object to be displayed, comprising:

providing a stream processor capable of identifying a path associated with a ray;  
generating a ray from a point on the object without accessing pre-calculated  
geometry associated with the object;  
determining if the path of the ray intersects a surface; and  
calculating an approximation to a transfer function associated with at least one  
basis function, wherein the approximation to the transfer function represents a component  
of the secondary illumination features.

7. (original) The method of claim 6, wherein the method operation of  
providing a stream processor capable of identifying a path associated with a ray includes,  
reading data associated with the ray; and  
reading polygon data associated with the path.

8. (original) The method of claim 6, wherein the method operation of generating a ray from a point on the object includes,

determining a voxel traversed by a ray segment.

9. (original) The method of claim 8, further comprising:

if the path of the ray does not intersect the surface, then the method includes,

determining a next voxel traversed by a next ray segment.

10. (original) The method of claim 8, further comprising:

if the ray intersects a surface, then the method includes,

recording data associated with the location of the surface intersection; and

generating a next ray; and

if the ray does not intersect a surface, then the method includes,

reading data associated with a next voxel;

advancing the ray through the next voxel; and

repeating if the path of the ray intersects the surface.

11. (original) The method of claim 10, wherein the method operation of recording data associated with the location of the surface intersection includes,

determining if the surface intersection is a closest surface intersection.

12. (currently amended) A computer readable medium having program instructions for presenting lighting characteristics associated with a display object in real-time, comprising:

program instructions for executing a ray tracing algorithm through a stream processor, the program instructions for executing a ray tracing algorithm including;

program instructions for generating a ray associated with a point on the display object; and

program instructions for determining an approximation of a transfer function component using at least one basis function, the approximation corresponding to a center point of a texel associated with a corresponding point on the display object.

13. (original) The computer readable medium of claim 12, wherein the program instructions for determining a transfer function component of a lighting characteristic associated with the ray includes,

program instructions for determining whether the ray is within a view plane of a light source.

14. (original) The computer readable medium of claim 13, wherein if the ray is within the view plane of the light source, then the computer readable medium includes,

program instructions for determining a direct illumination component of the lighting characteristic.

15. (original) The computer readable medium of claim 13, wherein if the ray is not within the view plane of the light source, then the computer readable medium includes,

program instructions for determining a self interreflection component of the lighting characteristic.

16. (original) The computer readable medium of claim 12, wherein the program instructions for generating a ray associated with a point on the display object includes,

program instructions for applying one of a biased approximator and an unbiased approximator.

17. (currently amended) A computer readable medium having program instructions for determining secondary illumination features for an object to be displayed, comprising:

program instructions for accessing a stream processor capable of identifying a path associated with a ray;

program instructions for generating a ray from a point on the object without accessing pre-calculated geometry associated with the object;

program instructions for determining if the path of the ray intersects a surface; and

program instructions for calculating an approximation to a transfer function associated with at least one basis function, wherein the approximation to the transfer function represents a component of the secondary illumination features.

18. (original) The computer readable medium of claim 17, wherein the program instructions for accessing a stream processor capable of identifying a path associated with a ray includes,

program instructions for reading data associated with the ray; and  
program instructions for reading polygon data associated with the path.

19. (original) The computer readable medium of claim 17, wherein the program instructions for generating a ray from a point on the object includes,

program instructions for determining a voxel traversed by a ray segment.

20. (original) The computer readable medium of claim 19, further comprising: if the path of the ray does not intersect the surface, then the computer readable medium includes,

program instructions for determining a next voxel traversed by a next ray segment.

21. (original) The computer readable medium of claim 19, further comprising: if the ray intersects a surface, then the computer readable medium includes,

program instructions for recording data associated with the location of the surface intersection; and

program instructions for generating a next ray; and

if the ray does not intersect a surface, then the computer readable medium includes,

program instructions for reading data associated with a next voxel;

program instructions for advancing the ray through the next voxel; and

program instructions for repeating if the path of the ray intersects the surface.

22. (original) The computer readable medium of claim 21, wherein the program instructions for recording data associated with the location of the surface intersection includes,

program instruction for determining if the surface intersection is a closest surface intersection.

23. (currently amended) A method for calculating an approximation to a transfer function defined by at least one basis function for rendering shading characteristics of an object in real time, comprising:

identifying a point on the object;

calculating a lighting function for the point, the calculating including;

applying a ray tracing algorithm through a stream processor without accessing pre-calculated geometry associated with the object;

determining a direct illumination transfer function for the point in real time; and

determining a secondary lighting contribution in real time through a series of multiply and add operations applied to data resulting from the ray tracing algorithm.

24. (currently amended) The method of claim 23, wherein the multiply and add operations are performed by the stream processor without calculating the lighting function at triangle corners.

25. (original) The method of claim 23, wherein the method operation of applying a ray tracing algorithm through a stream processor includes, defining a ray through a biased approximator.

26. (original) The method of claim 23, further comprising:  
repeating the identifying and the calculating for multiple points on the object.

27. (original) The method of claim 26, wherein the method operation of repeating the identifying and the calculating for multiple points on the object includes,  
performing the calculating for a portion of the multiple points during a first frame of image data, and

performing the calculation for a remainder of the multiple points during a next frame of image data.

28. (currently amended) A method for calculating a lighting function for an object to be rendered using a basis function, comprising:

calculating a transfer function approximation of the lighting function through a stream processor, the lighting function being sampled at a center of a texel.

29. (original) The method of claim 28, wherein the transfer function approximation is associated with the basis function that characterizes a global illumination associated with the object.

30. (original) The method of claim 28, wherein the transfer function approximation is a set of coefficients configured to describe a surface reflectance.

31. (original) The method of claim 28, further comprising:  
rendering the object.

32. (original) The method of claim 31, wherein the method operation of rendering the object includes,  
linearly interpolating a color of the object across a polygon.

33. (currently amended) A computer readable medium having program instructions for calculating an approximation to a transfer function defined by at least one basis function for rendering shading characteristics of an object in real time, comprising:

program instruction for identifying a point on the object;  
program instruction for calculating a lighting function for the point, the program instruction for calculating including;  
program instruction for applying a ray tracing algorithm through a stream processor without accessing pre-calculated geometry associated with the object;  
program instruction for determining a direct illumination transfer function for the point in real time; and  
program instruction for determining a secondary lighting contribution in real time through a series of multiply and add operations applied to data resulting from the ray tracing algorithm.

34. (original) The computer readable medium of claim 33, further comprising:  
program instruction for repeating the identifying and the calculating for multiple points on the object.

35. (original) The computer readable medium of claim 34, wherein the method operation of repeating the identifying and the calculating for multiple points on the object includes,

program instruction for performing the calculating for a portion of the multiple points during a first frame of image data, and  
program instruction for performing the calculation for a remainder of the multiple points during a next frame of image data.

36. (currently amended) A computer readable medium having program instructions for calculating a lighting function for an object to be rendered using a basis function, comprising:

program instructions for calculating a transfer function approximation of the lighting function through a stream processor, the lighting function being sampled at a center of a texel.

37. (original) The method of claim 36, wherein the transfer function approximation is associated with the basis function that characterizes a global illumination associated with the object.

38. (original) The method of claim 36, wherein the transfer function approximation is a set of coefficients configured to describe a surface reflectance.

39. (currently amended) A computing device, comprising:  
a graphics processing unit (GPU) capable of determining lighting characteristics for an object in real time without accessing pre-calculated geometry associated with the object, the lighting characteristics defined through a basis function, the GPU including a stream processor configured to split a stream of data associated with the lighting characteristics into multiple simultaneous operations.

40. (original) The computing device of claim 39, wherein the computing device is a video game console.

41. (original) The computing device of claim 39, further comprising:  
a display screen in communication with the GPU, the display screen configured to present image data representing the object.
42. (original) The computing device of claim 39, wherein the stream processor is a programmable hardware unit capable of executing code that is replicated multiple times.
43. (original) The computing device of claim 42, wherein the code that is replicated multiple times is configured to process one of a ray tracing algorithm and multiply and add operations for data derived from the ray tracing algorithm.
44. (currently amended) The computing device of claim 43, wherein the ray tracing algorithm determines a direct illumination lighting characteristic in real time for multiple points on the object and the multiply ~~an~~ and add operation determine a secondary lighting characteristic in real time without calculating the lighting function at triangle corners.
45. (original) The computing device of claim 39, wherein the GPU is further configured to render the object through a process involving linear interpolation, such that the lighting characteristics are applied to the rendered object.

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46. (original) The computing device of claim 39, wherein the basis function is one of a wavelet and a spherical basis function.